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IN THIS ISSUE

The 'Rab' System of Paddy Cultivation.

Twenty Years of Manuring Paddy with Artificials.

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The Mysore Agricultural Journal

(The Organ of the Mysore Agricultural and Experimental Union)

Vol. XXIII] JULY—SEPT. 1944 [No. 1

EDITORIAL

In the current number of the *Journal of the Agricultural and Experimental Union*, we have published an article written by Dr. B. Narasimha Iyengar, B.A., Ph.D. (Göttingen), the Retired Director of Agriculture in Mysore. This article, coming as it does, at this period when Food Production is engaging great attention of statesmen and ryots, is particularly welcome. The results of the Paddy Manurial Work narrated in the article are very encouraging and point a way as to how we can build up soil fertility by judicious manuring over a long period of time and also step up production on a given area.

Dr. B. Narasimha Iyengar was the Agricultural Chemist of the Department of Agriculture for a long period and the present paddy manurial trials were opened as long back as 1924, and he still continues to give necessary guidance to the proprietor of the lands.

Though the results reported upon are not those of a strictly conducted experiment, yet the results can be taken as an index of what can be done on lands irrigated by a perennial channel and also the soil conditions being typical of the region concerned.

This is a unique undertaking by a proprietor and so far we are aware, there is no parallel in Mysore to show any other similar trial conducted over such a long period. The average yields have increased from 8·78 pallas in the first year to a maximum of over 17½ pallas in 20 years. Even in the first 5-year period the yield has gone up by 5 pallas to the acre. Therefore the results of a properly balanced manuring on paddy are clearly obvious.

In Mysore State, under the 'Grow More Food Campaign', the Department of Agriculture has been distributing manures for paddy cultivation to the tune of several lakhs of rupees and it is hoped that our paddy output will be substantially increased to bridge the gap between the total production in the State and consumption.

The 'Rab' System of Paddy Cultivation

PART I

An Investigation into Its Nature and Value

By M. J. Narasimhan, B.A., *Director of Agriculture in Mysore*

The 'Rab' system of paddy cultivation is an unknown practice in Mysore. A form of cultivation known as 'KUMRI' is in vogue in the malnad parts of the Mysore State, closely analogous to the 'Rab' system. 'KUMRI' cultivation consists in clearing and burning a scrub on the slope of a hillock; the ash is mixed with the soil either by digging or ploughing and paddy is sown after the onset of the monsoon rains in the month of July. Excepting that the land is burnt in both the cases 'Rab' and 'Kumri' cultivations are distinct from each other. The system of 'Rab' consists in burning cowdung, straw, dried grass, brushwood and branches of trees on the nursery bed and growing paddy seedlings which are afterwards transplanted into paddy fields. This method is followed by the cultivators in Western India so much so that many consider that without it, seedlings fit for transplantation would be difficult to get. This method of paddy cultivation in Western India has been reported upon by H. Day[1] as early as 1853. In 1885 a series of experiments made under the direction of Ozanne[2] were considered to settle the question of the utility of the process. The results were very striking and were summarised by Ozanne as follows:—

(1) Cowdung 'Rab' is decidedly superior to all other varieties and the better the soil and the better the season, the more is its superiority exhibited.

(2) That good results are obtained from 'Rab' made either from leaf or grass.

Knight[3] carried out a number of field experiments at Lonavla (Poona) in the years 1904 to 1910 and concluded that the greater part of the beneficial effect of the 'Rab' treatment may be attributed to the heating of the soil, and that results as good as those obtainable with the 'Rab' treatment could be obtained by manuring with nitrogenous manures, the most effective at lowest cost being oilcake, particularly, safflower cake.

H. H. Mann[4] and his co-workers have confirmed the above findings and their principal conclusion regarding the actual practical methods of preparing the rice seed-bed in Western India is that no method not involving a greater actual of out-of-pocket expenditure, seems likely to yield the results which are obtained with the combined application of heat and of wood ashes to the soil which is given in the 'Rab' process.

At the present time, due to war conditions, oilcakes and commercial fertilizers have become very scarce and costly. Moreover the problem of getting more food from the land has become the most important and pressing problem of the present day. As it appeared possible to grow more food by adopting the 'Rab' process, experiments were started to investigate the suitability of the 'Rab' process for growing more paddy in Mysore.

The 'Rab' process appears to be wasteful of cowdung and fuel. But at least in the Irwin Canal area where thousands of acres of sugarcane is grown, sugarcane trash is easily available. Experiments were therefore started on the Irvine Canal Farm, Mandya District, Mysore, using sugarcane trash and cowdung for the 'Rab' process.

It is the experience of every ryot that well grown, healthy paddy seedlings transplanted at the right age yield a good crop. It is therefore believed that

seedlings heavily manured in their seed beds should after transplantation yield more than seedlings raised in the ordinary way. The extraordinary growth of the seedlings grown under 'Rab' system may therefore result in greater yield after transplantation than those raised in the ordinary manner.

Two plots each measuring 1/100 of an acre were selected. On one plot sugarcane trash and dry cowdung were arranged in alternate layers to a height of about 1½ feet and the top surface was covered over with a thin layer of moist earth. The heap was burnt and the ash was incorporated into the soil. The control plot was prepared in the usual manner in which the ryots prepare their seed bed receiving farmyard manure at the rate of 20 cartloads per acre. S 705 variety of paddy was sown in both the plots on 15-2-1944 and later transplanted on eight one-gunta plots for each treatment in a randomised block. A uniform treatment for all the 16 plots was given and is described below:—

Green manure at 3,000 lbs. per acre ploughed in 3 weeks before transplantation and farmyard manure or compost at the rate of 3,000 lbs. per acre applied 4 weeks before transplanting. 100 lbs. per acre of paddy mixture was given to all the plots before transplanting.

Date of transplanting the seedlings: 25-3-1944.

Date of harvest: 5/7-7-1944.

Yield of Grain and Straw per plot of one gunta (air dry wt.)
Variety of Paddy—S 705 (Bangara Kaddi)

Treated			Not treated		
Plot No.	Grain	Straw	Plot No.	Grain	Straw
	lbs.	lbs.		lbs.	lbs.
1	58·5	84·0	2	39·6	57·7
3	32·4	43·8	4	29·3	33·2
5	35·1	29·9	6	27·5	39·1
7	46·8	56·2	8	37·8	46·7
9	45·9	60·6	10	43·7	66·1
11	44·6	71·2	12	30·6	39·1
13	37·4	49·3	14	49·5	68·5
15	47·3	54·8	16	23·4	37·9
TOTAL ..	348·0	449·8	TOTAL ..	281·4	388·3

When the above data was submitted to statistical analysis, it was found that the differences in the yield of grain due to the treatment to the seed bed approach significance while those for straw are not significant.

Average Yield of Grain and Straw per acre

Treatment	Grain	Straw	Grain
	lbs.	lbs.	seers
Cowdung rab treatment (nursery) ..	1,740	2,249	966
Raiyat's practice „ ..	1,407	1,941	782

Thus the field trial has shown that the 'Rab' treatment of the seed bed is superior to the ordinary raiyat's practice as it has yielded 333 lbs. or 1·84 pallas of paddy per acre more than the ordinary method of cultivation.

The following further field observations were made during the course of the experiment:—

(*a*) Planting two seedlings per hole, the seedlings from the 'Rabbed' seed-bed covered one and a half times the transplanted area as did the seedlings from the 'Control' seed bed.

(*b*) The stand of the paddy plants in the field was more uniform in the case of the 'Rabbed' seedlings than with ordinary seedlings.

(*c*) The 'Rabbed' plants show distinct signs of earliness. They were the first to flower and to mature. These plots were ready for harvest 10 to 12 days earlier, than control plots.

PART II

Chemical Analysis of the 'Rabbed' and Control Seedlings

By M. Subbiah, B.A., *Biochemist*

In order to test the effect of 'Rab' treatment of the seed bed on the chemical composition of the seedlings, a definite number of seedlings were taken from both the treated and the untreated plots, care being taken that the seedlings had suffered as little loss of root as possible while removing them from their seed beds. The roots were carefully washed until all adhering particles of sand and soil were got rid of. The root and shoot were carefully separated by means of a pair of scissors and each was dried separately in a steam oven to constant weight. They were then cut into small bits and prepared for further chemical analysis. In the root and shoot samples of treated and untreated seedlings the following constituents were determined by the standard methods of analysis —Ash, Nitrogen, Phosphoric acid and Potash. The data obtained are presented in the following tables:—

Table I

Showing the weight (in grammes) of 100 seedlings—dry weight

	Untreated	Treated	% increase due to treatment
Complete plant (root and shoot combined)	4·766	7·154	50·10
Shoot ..	2·760	4·632	67·82
Root ..	2·006	2·521	25·50

In Table I, the dry weights of 100 seedlings are given. It may be seen from the data that the weight of seedlings has been considerably increased by the treatment given to the seed bed. By expressing the increase in weight over the control on a percentage basis, it will be seen that the seed bed treatment has increased the root by 25·5 per cent. and the shoot by 68·0 per cent., thus showing that the seed bed treatment has greatly increased the development of the seedlings.

TABLE II

Showing the data of the chemical analysis of the seedlings (on dry matter basis)

	Ash (per cent.)		Nitrogen (per cent.)	
	Untreated	Treated	Untreated	Treated
Shoot ..	20·77	21·01	1·367	1·774
Root ..	18·42	15·44	1·096	1·228
	P_2O_5 (Phosphoric acid)		K_2O (Potash)	
Shoot ..	0·763	1·024	3·810	4·516
Root ..	0·409	1·184	0·975	1·647

Table II shows the chemical composition of the seedlings. Generally speaking the treatment of the seed bed has resulted in the increase of percentages of nitrogen, phosphoric acid and potash of the seedlings. With regard to phosphoric acid, the increase is quite pronounced. The untreated seedlings show 0·763 and 0·409 per cent. of P_2O_5 in the shoot and root portions respectively. These amounts have been increased to 1·024 and 1·184 per cents. respectively, by the treatment. In the same manner, the potash content of the root portion of the untreated seedlings has been raised from 0·975 per cent. to 1·647 per cent. by the treatment.

TABLE III

Showing absolute amounts of plant food constituents absorbed by 100 seedlings

Portion of plant	Constituents removed (in grammes)							
	Ash		Nitrogen		P_2O_5		K_2O	
	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated
Whole plant	1·3623	0·9427	0·1132	0·0597	0·0773	0·0293	0·2496	0·1248
Shoot	0·9731	0·5733	0·0822	0·0377	0·0474	0·0211	0·2092	0·1052
Root	0·3892	0·3695	0·0310	0·0219	0·0298	0·0082	0·0355	0·0196

Table III gives an idea of the absolute amounts of plant food constituents removed by 100 seedlings. The treated seedlings removed nearly double the amount of the nitrogen and potash and more than 2·5 times of phosphoric acid from the soil as do the untreated seedlings. This 'luxury' consumption may perhaps be due to the fact that the 'Rab' treatment has rendered readily available large quantities of plant food elements in the soil.

TABLE IV

Total nutrient content		Amount of each constituent expressed as percentage of the total		
		N	P_2O_5	K_2O
		(a) Analysis of Shoot		
Treated	7·314	24·26	14·0	61·74
Not treated	5·940	23·01	12·85	64·14
		(b) Analysis of Root		
Treated	4·059	30·25	29·16	40·59
Not treated	2·480	44·19	16·50	39·31

In Table IV is expressed the total nutrient content and the amount of each expressed as percentage of the total. By comparing the percentage ratios of nitrogen, phosphoric acid and potash of the treated and untreated samples of the aerial portions of the seedlings, it will be seen that the ratios do not differ to any great extent from each other. But when the same comparison is made of the root samples, it will be observed that the percentage ratios for P_2O_5 differ considerably from each other, the treated seedlings showing 29·16 per cent. and the untreated samples showing only 16·5 per cent. In the case of potash the ratios are almost the same in both the cases. This observation seems to indicate that the lack of P_2O_5 in the soil has operated as a limiting factor in the development of the root and shoot portions of the seedlings and the 'Rab' treatment of the seed bed as described above seems to have rectified the above defect of the soil to an appreciable extent.

It may now be concluded that the present investigation into the nature and value of the 'Rab' treatment of the paddy seed bed seems to show (*a*) that the treatment brings into ready availability large quantities of plant foods, more especially phosphoric acid in the soil, as a result of which extremely vigorous and healthy seedlings are obtainable; (*b*) the transplantation of such treated seedlings results in appreciable increase of yield of paddy at harvest.

Further trials are already in progress to confirm the above findings.

The 'Rab' process as described above is both simple and inexpensive; after all the area to be burnt is not great. Every paddy cultivator can therefore easily adopt this 'Rab' system for either 'dry' or 'wet' nursery with beneficial results. The required quantity of cowdung and other combustibles may be easily collected from pastures and other places if attempts are made early enough, say from January and onwards.

REFERENCES

1 and 2. *Bulletin No.* 4 *of the Bombay Department of Agriculture*, published in 1886 by E. C. Ozanne.

3. J. B. Knight, *Bulletin* No. 63, Bombay Dept. of Agriculture, 1914.

4. H. H. Mann, N. V. Joshi and N. V. Kanitkar, "The Rab System of Rice Cultivation in Western India," *Memoirs of the Department of Agriculture in India*, Chemical Series, Vol. 2, pp. 141-91.

Some Facts about the Indian Bee (*Apis indica*)
(With special reference to Mysore)

By B. Krishnamurthy, B.Sc., F.R.E.S., *Entomologist*

Apis indica is one of four different varieties of honey-bees known in India. It stands out from the others, because of its special characteristic of being amenable to housing in an artificial enclosure. Although living in nature in the crude and dark hollows of tree trunks and branches, this honey-bee does not object to being transferred to a man-made hive affording better shelter and facilities for colonisation; nor does it resent frequent and gentle handling so long as human interference is in furtherence of the normal work and interests of the individual bee and the colony as a whole.

The possibility of such interference in the case of this bee appears to have been realised in rural parts all over India, specially in hilly and forest tracts actually hundreds of years ago. The village-folk gathered swarms issuing out of their natural habitations and settling in earthen pots, 'Skeps', and bamboo or other decoys previously thrown about by them in forest areas and took them home. When honey was found stored by the bees in their combs it was crudely squeezed out (along with eggs and larvæ in the cells) after first smoking the bees away. Pots and decoys thus emptied were again distributed in the forest areas for collection of other swarms and so on.

Domestication

It should be admitted that this crude manner of bee-rearing long in practice in this country, made hardly any contribution towards improving the reaction on the part of the bee to artificial conditions and human handling—in other words—domestication. On the other hand, in consequence of the very rough and inconsiderate usage meted out, the bee clearly developed a tendency to easy irritability or offensive stinging.

It is only about the very early part of this century that attempts were begun in India at domesticating the bee by means of better methods. The modern wooden bee-hive was introduced to take the place of the earthen pot for housing the colony and the centrifuge for the extraction of honey without destroying the comb or crushing the brood. The constructional details of the hive facilitated gentle and frequent handling of the clusters of bees and ministering to their wants in times of stress or danger. These and other improvements offered scope not only for more and better domestication of the bee but also for the deriving of fuller benefits by the bee-keeper. But the rate at which the improved methods were adopted by bee-keepers more especially in the rural areas has been extremely slow. A tremendous lot of continued stimulus is still needed to bring about any appreciable change in the outlook of the village bee-keeper and unless and until improved methods are generally adopted no real domestication is ever possible and without a fairly well domesticated bee, honey production cannot be increased to any satisfactory extent.

Start in Bee-keeping

To make a start in bee-keeping with the Indian bee, one has at present to turn to the natural sources in forests, plantations, gardens, avenue trees or casual swarms temporarily settling on branches and other supports, for one or

more clusters of bees; and every time he thinks of increasing the number, he has almost invariably to turn to the same source. This in itself involves a lot of labour, time and expense, not to say anything of the uncertainty and possible danger attendant on such ventures. The actual operation of transferring the bee clusters from their natural haunts into artificial hives, requiring, as it does, a good deal of patience, practice and experience, does not always mean, either, that the desired results are assured. One of the commonest occurrences subsequent to an operation of transfer of a cluster is dwindling or complete desertion from the hive. The causes bringing about this disheartening result are generally always faulty and ill-timed operation, mutilation or even death of the queen, inadequacy or entire absence at the time of nectar-secretion in the flora of the locality or unexpected trouble from carnivorous ants and predatory wasps or, as it often happens, eagerness or over-enthusiasm on the part of the bee-keeper meddling too often, which does more harm than good. Unsatisfactory results and failures are all the more common when the hived cluster of bees happens to have an aged queen whose egg-laying capacity is fast, waning; with a decrepit queen and little or no nectar in the nighbourhood dwindling or desertion keeps on happening as often as similar conditions repeat. Is it any wonder, then, that failures are far too frequent in bee-keeping practised under the existing circumstances and numerous aspirants to developing a profitable hobby or running a side business or building up an industry on a commercial scale, have become disllusioned and given it up as hopeless?

These defects cannot be removed unless by the adoption of better methods of commencing and increasing and an actual study of the bee flora of the locality to make certain that it is suitable. Two very essential preliminaries for a successful start are a young and vigorous queen in the cluster of bees in the hive and a fairly rich and actively secreting group of blossoms in the apiary and in the immediate nighbourhood. It is very important that there should be several centres or agencies having either well-established populous clusters or nuclei of bees with vigorous queens for distribution among bee-keepers; a supply of fresh and young queens is to be drawn from a stock of artificially bred queens in those centres. A populous colony of bees can be safely divided into two; while one half retains the queen present in the original single colony, the other half may be supplied with an artificially bred queen. Such a procedure is the most logical and scientfic and sure way of increasing the number of colonies in an apiary. Although the work of breeding queens is somewhat specialised it can be undertaken by any experienced bee-keeper anywhere under certain conditions. When a regular supply of vigorous queens and nuclei of colonies consisting of 2–4 combs of fresh brood and some nectar and pollen in the cells is organised, a successful start as well as a periodical increase in the number of working colonies become much simpler and far more certain than when the bee-keeper has to tap the difficult and uncertain sources in nature. An organisation for the rearing of queens and supply of nuclei colonies to bee-keepers is a very important and necessary adjunct to any scheme of development in bee-keeping and should be given the consideration it deserves. The abundance of nectar-secreting flora in the area where such development is contemplated, is of course, an extremely essential condition for success, as pointed out earlier.

Capacity of the Bee and the Number of Colonies in a Locality

Of all the known domesticated honey bees, the Indian bee is about the smallest in size. Its proboscis is proportionately short and cannot tap deep-lying nectaries of many flowers in spite of the possibility of its protrusion forwards to a small extent by muscular action. The load of pollen grains that each field bee can carry per trip is limited by the small size of the pollen box on the hind pair of legs. The range of flight is confined to an average radius of 1½ miles in bright and still weather and may be much less in very warm and

stormy and rainy weather. The enemies of the Indian bee take a heavy toll especially when the colony is poor in numbers. The Rock-bee of India, the biggest and most powerful of the Indian honey bees, but wild and intractable, often molest and rob this smaller domesticated bee of its useful stores of honey because the latter is physically weaker and unable to resist an invasion. If Rock-bee colonies abound in localities where the Indian bee colonies are to be established, the former always prove irresistible competitors to the latter and several sources of nectar are easily lost to the smaller bee.

There are severe limitations on the number of prosperous colonies that a particular locality in any area can sustain. The number directly depends on the quantity and quality of bee-flora existing and thriving within the flight range of the bee. The flora, even if fairly suitable, cannot be expected to be continuously productive for the simple reason that seasonal conditions and factors of soil fertility, etc., do not always remain favourable. Nectar secretion in flowers is very much governed by certain optimum temperature and humidity and if the latter do not always obtain in the locality even though rich in bee-flora, the colonies suffer for lack of sufficient nutrition. Only those that have had a good start and that can tap old stores previously stocked tide over difficult periods while the others, in a less favourable situation, dwindle away, or become a prey to enemies and finally desert and disappear. That the flight range of the bee is inside a radius of only about 1½ miles, and that, within this range, there cannot be an unlimited quantity of suitable nectar-yielding flora, and that the flora, depending as they very much do, on favourable physical environmental factors, are not always productive and that within the narrow range of flight, there may always be the overlapping of the activities of bees of other colonies present outside the range but near enough, thus causing frequent competition among the members of the different colonies and a drastic drain on the already limited resources of nectar and pollen, are some of the major factors that seriously curtail the number of bee colonies that can be set up and made to yield profitable returns of honey in any locality. Clearly, therefore, no one can think of crowding in one's apiary or in any one locality, a number beyond a certain limit, even though one would wish to have hundreds of colonies. While this applies equally to any variety of domesticated bee anywhere in the world, the Indian bee is particularly badly affected. Granting that just the right number is installed in a locality, it would be a mistake to think that any one colony would yield the same quantity of honey as any other there. Each colony has its own individual capacity governed by factors both internal and external; in the matter of honey production, it should be judged on its own individual merits; for reasons peculiar to each colony, while one may produce heavily, others in the same locality or in one and the same enclosure, may produce less; a few may yield nothing at all for a long time. The average production per hive per year has been as low as 6 lbs., although isolated instances of colonies yielding 15–20 lbs., are met with; the latter are wholly exceptional and in their case a combination of several favourable factors would have operated simultaneously.

Bee-keeping as a Cottage Industry

It is well known that in the hill tracts all over India, and in the Malnad districts of this State crude methods of keeping bees in pots, etc., are in vogue for a long time and that small incomes are earned by the village folk by the sale of honey. There is plenty of scope for the villagers to produce more and much better honey and earn larger incomes, by adopting modern methods of rearing and extraction. While taking to better methods, they should, however, make serious attempts to get rid of the canker of callousness and criminal negligence towards the well-being of the bee colonies that is prevalent among them, which has been a very serious obstacle in the advancement of the industry, and which

causes utter despair in the staff appointed by the Government for helping the villagers in improving the status of the industry.

Large-Scale Honey Production

The Indian bee as it exists to-day, does not hold out bright prospects for honey production on a commercial scale. In the matter of the requisite kind and quantity of bee-pasture, the forest and hill tracts and the malnad areas of the State, no doubt, contain an abundance of rich material; but it is clearly very difficult to tap all the sources unless a large number of apiaries are set up and worked in the interior of the forests and the cultivated plantation areas. The continuous and heavy rainfall of three months' duration in the malnad also acts as a definitely injurious factor, not only by preventing the bees from actively foraging outside, but by facilitating the growth of mold inside the hives, and seriously limiting nectar secretion in the plants during the period. Unless the colonies have sufficient stocks of honey stored in the combs previous to the commencement of the rains and are artificially provided with sufficient warmth and are protected from inroads into their hives of their natural enemies; unless, therefore, very special care and attention are regularly and promptly bestowed on the colonies for the duration of the monsoon, they dwindle away into such poor stocks as would render their regeneration, later on, almost a matter of impossibility; in fact, such regeneration of dwindled colonies, even if it were possible, would involve efforts in time, cost and labour, not really worth any serious attempt. Besides, for any commercially profitable production of honey anywhere, apart from a well-domesticated and powerful bee, and natural forest sources of nectar, there should exist extensive areas of fruit trees of all kinds and nectar-yielding fodder crops like clover that form about the best and the richest sources of nectar. A large-scale commercial venture in honey production may have to be deferred to a considerably distant date; in the meantime, honey production as a cottage industry should receive a far greater incentive and should be placed on a sound foundation.

Twenty Years of Manuring Paddy with Artificials

By B. Narasimha Iyengar, B.A., Ph.D.
Retd. Director of Agriculture in Mysore

Consequent on the extension of irrigation in the Cauvery valley during the last 30 years, a large area of land which was formerly growing only rainfed crops such as ragi, *avare*, horsegram, etc., has become converted into paddy fields. One such area is a few miles away from the Hosa-Agrahara railway station on the Mysore-Arsikere line. As land was not very costly when irrigation was introduced into the area, many people in Mysore and Bangalore invested their money on land in that area. Among these was a friend of mine in Bangalore who had purchased an area of 27 and odd acres and had given it for paddy cultivation on the *varam* or share system—the cultivating tenant providing all the labour and cattle manure and taking half the quantity of grain produced and the whole of the straw. Owing to scarcity of cattle and green manure in the area, the land in question was not producing more than 300 seers or 540 lbs. of paddy per acre. Such a state of affairs was not profitable to the landlord at least.

Having tried sulphate of ammonia on my advice for sugarcane on his lands near Bangalore with very satisfactory results, he sought my help and advice with regard to raising the yields of these paddy lands also in the early part of 1924. The whole area of 27 and odd acres was being cultivated by 14 tenants, each handling an area varying from 20 to 82 guntas or from 50 to 205 cents.

The nature of the soil being mostly sandy and gravelly, and organic manures of any kind—either farmyard or green manure—being scanty in the locality, it was thought advisable to use oilcakes as the source of nitrogen when making up the mixtures needed. Various paddy mixtures were tried during the first year, but as the work was found to be too complicated to be put through efficiently to the satisfaction of the landlord, tenants and oursélves as well, work during succeeding years was confined to the trial of a single mixture, consisting of groundnut cake, castor cake and superphosphate in certain proportions and applied at the rate of 320 lbs. per acre just before transplanting the paddy seedlings. The mixture was made up of three parts of groundnut cake, 3 parts of castor cake and 4 parts of ordinary super. The quantity of the mixture used as manure supplied about 12 lbs. of nitrogen and 20 lbs. of phosphoric acid per acre. The cost of the mixture applied was about Rs. 25 per acre to start with and gradually came down to Rs. 15 as materials became cheap. Since the present war, the cost has mounted up to even beyond Rs. 25 per acre.

In some years, concentrated superphosphate was used instead of ordinary super but since the quantity of the mixture had to be maintained at the level of 320 lbs. per acre to satisfy the cultivator, the proportions of groundnut and castor cakes in the mixture were varied keeping constant the quantities of nitrogen and phosphoric acid supplied per acre.

As during the last 3 seasons, it has become very difficult to procure superphosphate at reasonable rates, calcined tricalcic phosphate and bonemeal have been used instead. The quantity of manure per acre and the amount of plant-foods have still been kept at the same level as before.

Since in preliminary experiments conducted with paddy in pots and small plots, it was found that phosphoric acid had a definite influence in ensuring uniformity in the stand of crop as well as in ripening, it was decided not to try

nitrogenous manures alone in this work which was meant to serve as a sort of demonstration and propaganda in the area concerned. As it had also been found in pot experiments that the best results were obtained when the ratio of nitrogen to phosphoric acid was as 2:3 for Mysore soils, the same ratio was maintained in the mixture applied as well.

Results of work during the first 4 seasons have been published in Vol. 8, Nos. 3 and 4 of *The Journal of The Mysore Agricultural and Experimental Union.*

Statement of yields for the area cultivated by each tenant had been maintained accurately for every year and acre yields have been calculated from those figures. As records for the middle period of 10 years have been mislaid, plot yields for the first and last 5 years only have been given in Tables 1 and 2. The statement below gives data as regards maximum, minimum and average acre yields for 10 seasons for the whole area of over 27 acres.

Season	Yield of paddy in seers per acre		
	Maximum	Minimum	Average
1924–25	1085	460	878
1925–26	1173	476	924
1026–27	1187	636	964
1927–28	1620	1056	1267
1928–29	1710	1090	1370
1939–40	2081	1348	1639
1940–41	1950	1264	1542
1941–42	2266	1410	1706
1942–43	2296	1444	1749
1943–44	2296	1485	1770

A glance at the above table shows that the yield has been steadily rising and shows a tendency to have settled down only during the last 3 years. As previously stated, the average yield per acre before manuring with artificials was started was only 300 seers of paddy and it trebled itself during the first year of manuring. During the 20 years of continuous manuring the average yield has again doubled itself, rising from 878 to 1,770 seers per acre. Another noticeable feature is that the gap between maximum and minimum yield has been steadily decreasing in successive years. Where the maximum was more than twice the minimum during the first year, it has shown an increase of only 50% over the minimum in the 20th year of manuring. Even the existing difference may be due to soil variation and difference in attention paid to cultivation by individual tenants.

The standard yield of paddy for the locality in which the lands are situated (Krishnarajapet taluk, Mandya district), is only 1,200 seers per acre. From figures given above, it is seen that even the minimum yield is above the standard yield while the average yield exceeds it by about 50%.

The maximum obtainable yield of paddy under very good conditions in Mysore may be put down at 3,000 seers or 5,400 lbs. per acre, and it remains to be seen whether that yield can be obtained by the present system of manuring alone in course of time. The work incidentally shows the way in which soil fertility can be steadily built up through a judicious system of

artificial manuring, using only a small quantity of cattle manure and that too not exceeding 3 or 4 cartloads per acre.

Coming now to various periods during the 20 years, the 4th year, *i.e.*, the season of 1927–28 shows a considerable increase over the crop of 1926–27. The average for the whole area has risen from 964 to 1,267 seers, *i.e.*, by 300 seers or 540 lbs. per acre. As during this season, the variety of seed used was changed from local *kaddi sanna* to the variety G.E.B. 24 of Coimbatore, part at least of the increase has to be attributed to the new variety of seed used.

At the end of the next period, *i.e.*, betweeen 1928–29 and 1939–40 there has been an increase of nearly 270 seers or 486 lbs. in the average yield per acre. This can only be attributed to the building up of fertility in the soil due to continuous manuring. In the next period of 5 years, *i.e.*, between 1939–40 and 1943–44 the average yield per acre has risen by 130 seers or 234 lbs. This is just one half of the increase during the last ten-year period, and works out to about 27 seers or 49 lbs. per acre per year.

The whole work is a good example of what can be done by an intelligent enterprising landlord to benefit himself and his tenants and incidentally increase agricultural production in the country.

TABLE I

Yield of Paddy in Seers per Acre

Plot No.	Area in guntas	1924–25	1925–26	1926–27	1927–28	1928–29
1	74	789	900	897	1,270	1,286
2	50	1,085	957	1,023	1,228	1,228
3	44	1,085	957	1,023	1,228	1,228
4	74	1,073	1,163	1,097	1,267	1,280
5	74	969	1,173	1,187	1,391	1,362
6	41	569	1,105	1,013	1,475	1,387
7	22	569	1,105	1,013	1,620	1,687
8	41	569	1,105	1,013	1,300	1,366
9	41	968	1,114	1,150	1,238	1,366
10	48	867	1,008	1,058	1,094	1,375
11	35	782	1,074	1,099	1,121	1,288
12	33	722	943	909	1,278	1,263
13	49	831	1,029	842	1,249	1,267
14	23	978	1,120	1,008	1,346	1,538
15	22	978	1,120	1,008	1,227	1,556
16	41	943	878	872	1,221	1,372
17	20	477	916	864	1,188	1,548
18	32	477	755	1,130	1,552	1,710
19	82	547	813	927	1,335	1,256
20	42	547	813	927	1,009	1,445
21	20	460	648	636	1,230	1,360
22	58	460	648	636	1,230	1,182
23	32	460	476	712	1,175	1,090
24	30	460	720	773	1,157	1,563
25	64	460	669	891	1,423	1,263
Average for the whole area		878	924	964	1,267	1,370

N.B.—1 gunta is 1/40 of an acre or 2½ cents. 100 seers of paddy weigh 180 lbs.

When a number of plots were harvested together in any year, only average yield from that area is given for each individual plot, *e.g.*, plots 21–25 in 1924–25, 21 and 22 in 1925–26, etc.

TABLE II

Plot No.	Area in guntas	1939-40	1940-41	1941-42	1942-43	1943-44
1	74	1,615	1,600	1,765	1,845	1,850
2	50	1,589	1,589	1,687	1,650	1,731
3	44	1,623	1,460	1,656	1,733	1,886
4	74	1,620	1,590	1,600	1,700	1,705
5	74	1,545	1,453	1,510	1,515	1,485
6	41	1,948	1,822	1,714	1,900	1,950
7	22	1,800	1,900	1,916	1,934	1,850
8	41	1,400	1,400	1,430	1,550	1,500
9	41	1,730	1,500	1,700	1,500	1,624
10	48	1,517	1,264	1,472	1,465	1,541
11	35	1,620	1,600	1,650	1,666	1,692
12	33	1,900	1,623	1,745	1,700	1,805
13	49	1,617	1,700	1,918	1,912	1,860
14	23	1,900	1,920	2,220	2,296	2,296
15	22	1,884	1,868	1,951	2,186	2,018
16	41	1,809	1,700	1,900	1,980	1,963
17	20	1,850	1,662	1,850	2,128	1,962
18	32	2,081	1,950	2,266	2,081	2,197
19	82	1,354	1,354	1,534	1,444	1,500
20	42	1,620	1,644	1,770	1,780	1,712
21	20	1,495	1,800	1'680	1,850	2,018
22	58	1,348	1,392	1,410	1,681	1,700
23	32	1,607	1,434	1,525	1,735	1,735
24	30	1,541	1,602	1,626	1,825	1,801
25	64	1,757	1,619	1,920	1,907	1,918
Average for the whole area		1,639	1,542	1,706	1,749	1,770

N.B.—1 gunta is 1/40 of an acre or 2½ cents. 100 seers of paddy weigh 180 lbs.

Note on Dr. B. Narasimha Iyengar's Paper on 20 Years Trials with Artificials

By B. T. Narayanan, B.A. Ph.D., D.I.C.

I consider it a privilege to add a brief note to the foregoing paper. The present programme of manuring which the Department is now advocating is in a large measure due to Dr. Narasimhiyengar at whose initiation and under whose distinguished guidance a review of the manurial requirements of paddy grown in Mysore under varying conditions of soil and water supply were undertaken early in 1933-34. This review also became necessary on account of the very great advances which field studies had made within the last decade and the standardized statistical methods which made field experiments very nearly an accurate science.

Such a re-examination in pot, plot and field conditions naturally took a long time and the results were only available for general application two to three years ago. They are briefly as follows:

In general on Mysore Soils at present—

1. An application of bulk organic manures like Farmyard manure or green manure or both as a basic operation is essential to obtain the best out of an application of fertilizers. Even green manure alone at 6,000–8,000 lbs. level gives at least 20 per cent. increase in yeild and moreover has beneficial residual effects.

2. A minimum additional application of 15 lbs. of nitrogen to the acre is necessary for profitable returns of crop and applications of over 30 lbs. are not economical at normal price levels.

Moreover this nitrogen can be equally applied as cakes, inorganic fertilizers or preferably a combination of both. According to the conditions under which the crop is grown, an increase varying from 10 to 33 per cent. can be obtained in the first year alone.

3. So far as yields are concerned, response to phosphates is not conclusive and that to potash is negligible. Nevertheless, it is observed that a supply of at least 8 to 12 lbs. of P_2O_5 as addition to the dose of nitrogen is necessary to maintain physiological equilibrium and soil fertility status. Applications of greater amounts of phosphates than 15 lbs. seem to be at present un-economical even on lateritic soils which alone in Mysore seem to respond immediately to phosphatic manuring.

The paper itself has come at a most opportune time when there is every need to stress the advantages of balanced and judicious manuring. The distinguished writer has rightly sounded a warning that application of manures (every ryot does apply some manure or other to his land) must not mean un-balanced manuring which only adds to the cost of production and may result eventually in loss.

A Note on Casuarina Cultivation

By D. M. Narasinga Rao, B.Sc., B.Sc. (Ag.)
Headmaster, R. K. Shala, Anekal

The war and later events have demonstrated with a striking force the need for planned economy in food and fuel production of the State. Next in importance to food for an urban family is fuel. The recent fuel crisis in big towns of the State has brought to light the importance of fuel production on economic lines. Casuarina cultivation occupies an unique place in solving this serious problem. It is the only fuel plant that can be grown successfully by any farmer on a plantation scale.

Cultivation of casuarina tope is to be seen round about Bangalore. The soil and favourable marketing facilities are said to be the contributive factors for the cultivation of the same in this locality.

Nursery

Casuarina is propagated by seeds removed from ripe fruits of 8-10 years old trees which are healthy and sturdy. Such fruits are gathered in the hot weather of January or February. They are put in earthen pots and allowed to bake in the hot sun when they burst, shedding their inside seeds which are carefully collected and preserved. During March suitable land with good irrigation and drainage facility is selected and is ploughed several times to bring the soil to fine tilth. Hand-digging is resorted to as in the case of other garden land crops in lieu of ploughing. Then the area is marked into beds of convenient size usually 4′ × 3′ with the necessary irrigation channels in between them. Cattle manure is applied to these beds at the rate of about 2 to 3 baskets per bed amounting to 40 to 60 lbs. Manure is mixed well and seeds are sown by broadcasting evenly in these beds and is covered with ash mixed with fine manure. These beds are protected from severe sun by covering with straw or green leaves, till the seeds germinate which may take 8–10 days. The nursery is regularly watered, care being exercised not to give too much or too little. Optimum moist conditon is maintained for good germination. The nursery bed is kept free from weeds and ants. When they are 2½ to 3 months old these seedlings are transplanted in a separate nursery before they are finally removed for planting in the field. For one acre planting 12 square yards of nursery is raised which takes about ¾ lb. of seeds. The bed of second nursery is prepared on the same lines as in the first stage. In this second nursery spacing of 3 inches apart between the seedlings is given while transplanting. Seedlings in one square yard of the first nursery may occupy an area of about ten square yards in the second nursery. The seedlings will be about half a foot high at this stage of transferring which is usually done in April or May. During the period when the seedlings remain in the second nursery, weeding and copious irrigations at regular intervals are given. The seedlings are allowed to remain here for a further period of 3½ to 4 months till they attain a height of 2 to 3 feet before final transplanting in the field when they attain an age of 6 to 8 months in all.

Since the process of securing the seeds from fruits and raising of the first nursery involves great skill and labour, it is a common practice among some of the ryots who intend to plant casuarina *tope* to purchase the seedlings from reliable nursery men. Site for this second nursery planting is selected as before

in good soil with free natural drainage. The cost of seedlings for each bed of 3′ × 2′ of the first nursery may vary depending upon the availability and demand for the seedlings in the locality during the season. Usually it costs Rs. 2 to 3¼ in normal years per bed. These seedlings are brought and transplanted. It is also the practice among the majority of ryots to purchase seedlings straight away at this stage instead of worrying themselves with nursery growing either at first or second stage. The cost of 100 seedlings varies from Rs. 4 to Rs. 6 in normal times.

Field Planting

Rich soils are not always necessary for casuarina planting. Poor sandy soils are quite enough. This is a factor which is to the advantage of the ryot whereby he can ungrudgingly release his poorer soils for raising this crop profitably. But care is taken while selecting the land that no rocky base is encountered under the sub-soil. Generally lands with poor surface soil with a good sub-soil which are unfit for cultivating any other farm crop profitably, are set apart for casuarina plantations. Sometimes waste lands are also reclaimed for this purpose in which case the area is cleared off from the shrub jungle and wild vegetation.

Three to six good ploughings are given during monsoon rains of June and July. In some lands horsegram is invariably grown as the first crop by broadcasting during the middle of August. The area is then marked with a six-feet marker either way as is done for tobacco planting. Small pits 1′ × 1′ × 1′ are dug at places where these lines intersect and are kept exposed for about a fortnight. During September, good soaking rain is taken advantage of to plant seedlings in these pits. Single seedling is planted in each pit when 1,250 seedlings are necessary per acre. Sometimes double seedlings are also planted to ensure safety in which case about 2,200 to 2,300 seedlings are required. No manure is applied while planting. If subsequsnt rains fail it is necessary to water once or twice till the seedlings establish well. Later on if the horsegram sown in the interspace is ready, it is pulled out and the remnants are ploughed in the soil during January. This intercrop of horsegram in the first year of plantation helps in enriching the soil with organic nitrogen.

During the early rains of the second year 2 to 3 ploughings are given in the interspace. Gaps if any are filled. Thinning is done if more than one seedling has been planted. An intercrop of either same or haraka is usually grown during the second year. Rarely castor can be seen as an intercrop during the first year and subsequently ratooned for two years in casuarina plantations.

Ploughed fallowing is resorted to during the third year of the plantation if the condition of the plant permits ploughing, for to do this, plants should be supple enough, to bend without breaking under the yoke while the plough works. Crooked plants are removed and lateral branches in all the trees upto a height of about 1½ feet from the ground are cut and used for fuel during the third year.

After three years practically no attention is bestowed on the plantation except to have a watch to prevent stray cattle damaging the plants. Thrice during the period upto six years lateral branches and side shoots are lopped off upto a height of six feet from the ground, and these are used for fuel. Plantation will be ready for cutting either for fuel or converting into charcoal after 10 years. Dry droppings under the plantations from 4 year onwards possess calorific value and as such are economically used by the villagers for their domestic purposes as well as to ignite fire and to supplement begasse fuel in jaggery boiling operations. It is the common practice of the ryots to sell plantation when ready, on the estimate of the standing crop to the dealers who trade with either fuel or charcoal. After the plantation is cut, dead roots are dug out before the land is brought again into cultivation. Some also ratoon the plantation when nearly 40 to 50 per cent. of roots will put forth fresh shoots,

Economic Aspects

Even during normal times casuarina planting is a paying concern as can be seen by the figures given below for the cost of cultivation and the expected yield per acre.

Cost of Cultivation

	Rs.	A.	P.
I Year—			
(*a*) Clearing rank vegetation	10	0	0
(*b*) Preparatory cultivation	5	10	0
(*c*) Cost of 1500 seedlings including fills for gaps in the second year at Rs. 5 per 1000	7	8	0
(*d*) Cost of 8 seers of Horsegram in first year for sowing	1	0	0
(*e*) Harvesting Horsegram and threshing	2	4	0
II Year—			
(*a*) Ploughing, etc.	2	14	0
(*b*) Cost of 6 seers of *same* for sowing	0	8	0
(*c*) Harvesting, threshing *same*	2	12	0
III to VI Years—			
(*a*) Lopping of side branches and carting	4	8	0
(*b*) Watch during 3 years at least for 5 months in the year at Rs. 2 per month	30	0	0
(*c*) Assessment at Rs. 1-8-0 for 10 years	15	0	0
Total ..	82	0	0

Yield

I Year—			
1½ pallas of horsegram at Rs. 8 per palla	12	0	0
½ cartload of dry horsegram husk and haulms ..	2	8	0
II Year—			
2 pallas of *same* at Rs. 5 per palla	10	0	0
¾ cartload straw	3	0	0
III to VI Years—			
6 to 8 carts of loppings at 6 to 8 annas	3	0	0
X Year—			
40 to 50 tons of fuel at Rs. 8 to 10 per ton	400	0	0
Total	430	0	0
Cost of cultivation ..	82	0	0
Net return ..	348	0	0

When distributed for 10 years, return per acre per year is about Rs. 35.

None of the other dry crops which are usually grown in poor soils, *viz.*, *Ragi*, Groundnut, Jola or Gingelly can give this amount of net yield per acre. Apart from use for fuel, casuarina *topes* have other utility values. In localities of high winds, casuarina *topes* re highly beneficial as wind-breaks. Being fast growing, the tree forms a good avenue along roadsides. Well-sized trees yield timber, rafters, poles, etc., for house building.

It is the common practice of the villagers, if a *tope* is available nearby to use the dry droppings under the *tope* for igniting the fire. If every village of the State where this plantation can be grown, owns at least one such *tope* and all the families of that village use casuarina dry droppings for igniting the kitchen fire instead of kerosene oil, considerable quantity of oil that goes to waste like this can be prevented. When so conserved, like tiny drops of rain that go to make an ocean, this huge quantity of kerosene saved can be advantageously utilised for other vital needs of the State. Lastly, this is a fit crop which can be taken up on business lines by any of the co-operative institutions or joint stock companies, to bring into cultivation waste lands around towns and to ensure regular and steady supply of fuel to cater to the needs of the public in each town of the State.

SELECTIONS

Home-Grown Vegetables for Health and Nutrition

Hints on Small-Scale Cultivation in Gardens

Increased cultivation of vegetable crops forms an important part of the Bombay Government's food drive. This type of agricultural produce is always in great demand by all classes of the community and is of vital importance in human nutrition.

Vegetable cultivation could be considerably increased if all owners of bungalows, gardens and open sites set aside a part of their compound or cultivable plot for this purpose, if only to supply their own requirements and those of their families. Such home cultivation is not only an absorbing and interesting hobby but, at the present time, represents a real contribution to the country's war effort.

In general, plots selected for vegetable cultivation in bungalow compounds should be well drained and not overshadowed by trees or buildings. Beds in which flowers have been successfully grown are usually suitable but portions of lawns may also be dug up and utilised for vegetable growing. If possible, plots which can be irrigated by the waste water from the bungalow kitchen or bathrooms should be selected as such sites make irrigation of the growing crops a simple matter. The soil should be at least a foot deep.

The type of soil is not of great importance in bungalow vegetable growing as there is such a wide range of vegetable crops that the cultivation of some varieties is possible on all classes of soil. When the plots are well manured, practically all vegetable crops can be successfully grown in bungalow gardens. If the bungalow compound is rocky and, in consequence, the surface soil is shallow, it will be necessary to import good soil and construct raised beds from 8 to 12 inches high upon which vegetable crops can be produced. Boxes, packing cases or baskets, can also be utilized for the production of vegetables such as lettuce, cress and tomatoes, where the cultivable land is restricted. Water must be available especially for the successful cultivation of vegetable crops in the non-monsoon seasons. The beds selected for vegetable cultivation must be protected from poultry, goats, dogs and other animals as these can do much damage in a vegetable garden.

Tools and Implements

Most bungalow gardens in which flowers and shrubs are being grown will already be equipped with the essential tools for vegetable cultivation. These tools are all hand tools and include the pick-axe (*kudali*), the spade (*phavda*), the hand-rake (*datale*), the hand-hoe (*khurpi*), the watering can (*zari*) and iron basket (*ghamela*). It is also most useful to possess a syringe or small hand-pump which can be used, if required, to apply insecticides to the growing vegetable crops. Other hand tools such as knives and secateurs which are used for bushes and ornamental plants, will also be found useful to the vegetable grower.

As soon as the bungalow owner has decided which vegetable crops he intends to grow, he should take steps to procure seeds from reliable seed dealers. The seeds should be ordered early in the season and well in advance

of the time for planting. After the first year, many garden owners will be able to preserve their own home-grown seed for further cropping. As, however, many of the better known vegetable crops as cabbage, cauliflower and knolkhol, do not produce seed under plains' conditions, the seed of such crops will have to be purchased annually. The seed of tomatoes, brinjal, bhendi, cucumbers, peas and beans, and most of other Indian vegetables can be grown locally. For this purpose, a few well-developed and healthy plants of these types of vegetables should be reserved each year for seed production.

Seed Purchase

In making purchases of seed, sufficient quantities of each type to be grown to allow for two or three sowings should be purchased as, at time, due to adverse whether conditions, the sown seeds do not germinate well and re-sowing is necessary. Before sowing, seeds should be carefully stored in a dry place in boxes, tins or bottles. Otherwise they are liable to be spoilt by dampness or insect or fungus attack. The use of naphthalene balls in containers in which seed is stored will minimise damage by insect pests.

It is not possible to prescribe any definite rules regarding the dimensions of beds for vegetable growing in bungalow gardens. In general, beds should not be more than 3 feet in width irrespective of their length as such width permits easy access to all parts of the bed for tillage purposes, without disturbing the soil. This is particularly true with regard to built-up beds. Existing flower beds of whatever size and shape will generally be found suitable for vegetable cultivation. When beds run parallel to each other, the paths in between should be kept dry by spreading over them coarse sand, gravel or broken bricks and stones. Do not use beds overshadowed by buildings or trees during the greater part of the day.

Beds intended for vegetable cultivation should, in general, be prepared in the same way as beds intended for flower growing. They should be well dug up to a depth of 10 to 12 inches and the soil broken down to fine particles all clods and lumps being shattered. Well-rotted farmyard or stable manure at the rate of 2 baskets (40 lbs.) for a bed of 3×4 feet should be applied to the soil and well mixed with it. The beds should be carefully levelled and may be given a slight slope to facilitate the run-off of excess surface rainfall. If it is proposed to devote part of a lawn to vegetable cultivation, the existing grass must be wholly removed both above and below ground.

If unused land is brought under vegetable cultivation, it must be thoroughly dug up, all grass and weed roots removed and manured. The vegetable area should be carefully planned out in advance and beds and paths marked out on the surface of the land. In coastal districts, where high rainfall is generally experienced during the monsoon season, raised beds of 8–12 inches above the surface of the surrounding soil, will generally be found most successful and small trenches should be dug along the sides of such raised beds to drain off surplus water. Too much water or excess of moisture resulting from inadequate drainage or waterlogging is fatal to successful vegetable cultivation.

Water is essential for the successful growing of vegetable in summer and winter seasons. The run-off waste water from the bungalow itself may be collected in small cement tanks, cisterns or barrels and used for irrigation purposes with advantage. In large gardens, a well or some permanent source of water supply is necessary.

It is not easy to lay down hard and fast rules regarding the watering of vegetable crops. In general, however, it may be said that more vegetable plots in bungalow gardens are ruined by over-watering than by under-watering. The drooping of the leaves of plants is an indication that watering is required and a hand examination of the soil just below the surface is also a good guide. If the soil is moist and sticks together when compressed in the hand, watering is not necessary.

The basic dose of two baskets (40 lbs.) of well rotted stable or farmyard manure should be mixed with the soil of a vegetable plot measuring 4 × 3 feet during preliminary and preparatory tillage. Additional manurial dressings, known as top-dressings, can generally be given with advantage after the vegetable crops are sown. Of these, well-powdered groundnut cake, applied just before the crop flowers in the case of flowering vegetables like peas, beans, tomatoes and bhendis or when the plants are about 6 or 8 inches high, in the case of non-flowering vegetables like cabbage, lettuce and knolkhol, at the rate of 1½ lb. of cake for each 4×3 feet of bed, will be found useful. As an alternative poultry manure at the rate of ½ lb. per bed of 4 × 3 feet can be used.

In regard to some types of vegetables, such as tomatoes, cauliflower, cabbage, knolkhol, onions, chillies, brinjals, brussel sprouts and lettuce, it is necessary to raise seedlings and subsequently to transplant these seedlings into the vegetable plots. Seedlings may be grown in earthen pots, wooden boxes or baskets, if required in small numbers, but if large quantities of seedlings are needed, a small raised bed of 4 × 3 feet should be made and the seed sown in it in lines 4 to 5 inches apart for seedling production. In general, such beds will not be found necessary to prepare sufficient seedlings for ordinary bungalow cultivation of vegetables. The seed should be sown thinly and watered through a nozzle with a fine spray daily until the seedlings are ready for transplanting. Seedlings can generally be transferred into the vegetable beds when 4 to 6 inches tall.

Sowing and Transplanting

A large number of vegetable crops such as peas and beans of all sorts, cucumbers, squashes, gourds, guar, carrots, bhendi, radish, turnip, beetroot, methi, coriander and spinach are grown direct from seed without transplanting. In the case of some vegetables such as methi, coriander, carrot and turnip, the seed is generally broadcast on the surface of the vegetable bed and raked in with a hand-rake before watering. Spinach is usually sown in lines. Beetroot and radish seeds are dibbled at regular intervals along the bed while others are raised as seedlings and subsequently transplanted. In such transplanting, the seedlings require to be raised carefully from the seed-bed with their roots intact and transplanting, with equal care in the bed. Transplanting of seedlings should always be done in the evening after the sun has gone down. Artichokes and potatoes are grown from tubers sown directly in the vegetable bed. In the case of cucumbers and squashes, the seed is usually dibbled in the round beds generally six seeds in the centre of each bed, and the creeping plants, when developed, are trained on supports made of bamboos or sticks.

The following seasons are suited for cultivation of various vegetable crops in different parts of the Bombay Province:—

May to October:—Peas, beans, tomatoes, chillies, onions (for green produce), lettuce, celery, brussel sprouts, spinach, radish, cucumber, lady's finger, gourds, pumpkins and yams.

September to February:—Carrot, turnip, cabbage, cauliflower, lettuce, beetroot, knolkhol, spinach, potatoes, radish, peas, tomatoes, onion, methi and gourds.

January to April:—Radish, lettuce, spinach, tomatoes, onion (for green produce), lady's finger, cluster beans, coriander, methi and bottlegourds.

In the coastal tracts of heavy rainfall, vegetable cultivation should be done on raised beds during the monsoon season. All vegetable beds require frequent weeding and stirring of the soil. Both these operations should be done when the soil is comparatively dry and not when the beds are very wet. Weeds should be picked out and removed as soon as they appear and as frequently as is found necessary. Regular cultivation will keep down weeds.

There are a number of insect pests and plant diseases which commonly affect vegetable crops and unless controlled, cause much damage and loss to the grower. The main insect pests are:—

Cut worms.—These insects generally appear in vegetable beds or fields at the early stage of growth of the crop. They live in the soil during daytime and only appear at night when they cut down the tender, young plants at the ground level. They are stout, smooth, cylindrical caterpillars, greenish black in colour and about an inch and a half in length when full grown. When disturbed they coil their bodies like millipedes. They are generally found singly here and there. Best method of control is to dig up the soil round about the cut plants and collect and destroy the caterpillars. Poison baits prepared from 25 parts of wheat bran to one part of white arsenic, moistened with water and molasses may be broadcast in the field at the rate of 10 to 15 lbs. per acre.

Thrips.—These insects generally attack onions, peas and chilli crops. They are minute insects, yellowish in colour with fringed wings. They are sometimes found in large numbers and cause whitish clotches on the leaves. In the case of chillies, the leaves get curled. They can be controlled by spraying the plant with a tobacco extract prepared by soaking one part (by weight) of tobacco waste (Dhus) in twenty parts of water for 24 hours with frequent stirrings during that period and then adding an equal quantity of water before use.

Aphis.—Commonly found on cabbage, knolkhol and cauliflower. These are small green insects which multiply rapidly and attack tender parts of the leaf surfaces. Give repeated sprayings with tobacco extract.

Beetles.—There are various types of beetles which eat holes in the leaves of vegetable crops and may cause much damage. Generally the beetles attack the crops at night. Dusting the leaves with fine ash mixed with kerosene in the proportion of 2 lbs. of the former with 1 oz. of the latter is a useful deterrent.

Caterpillars.—Many caterpillars damage vegetable crops by feeding on the leaves. These insects should be handpicked and destroyed.

Castor Cake as Manure

White ants.—White ants may cause damage in some vegetable plots. When this occurs, apply by means of a water-can to the soil round about the affected crop a one per cent. solution of crude oil emulsion. Phenyle solution may be used when crude oil emulsion is not available. The application of powdered castor cake as a manure will also serve as deterrent.

Mildew.—A fungus disease which damages peas and guar and which shows as an ashy white deposit on the surface of the leaves. A small quantity of fine flowers of sulphur should be placed in a muslin cloth and dusted over the plants.

Mosaic disease.—A virus disease which causes the leaves of certain vegetable crops, like tomatoes, to become mottled and stunted or curled in appearance. Remove and destroy the affected plants.

It must be remembered that attacks on vegetable crops by insect pests and plant diseases are most common when conditions for growth are unfavourable. Clean cultivation will reduce the risk of insect or disease damage.

Further information on vegetable growing can be obtained from the Horticulturist to Government or the Professor of Agriculture, Agricultural College, Poona.—*Bombay Information*, June 17th and 24th, 1944.

BOOK REVIEW

"Field Crops of India" with special reference to Mysore. By A. K. Yegna Narayan Aiyer, M.A., Dip. Agri. (Cantab.), N.D.D.

There is a paucity of authenticated and detailed information regarding crops grown in India. Mr. A. K. Yegna Narayan Aiyer's book on "Field Crops of India", fills the lacunæ tolerably well. It is a fairly comprehensive and exhaustive book on the Field Crops of Mysore, but the information pertaining to other parts of India is meagre. Although the author himself realises this limitation of the book, the work undertaken is ambitious and he has discharged the task with much erudition.

Several of the important economic crops are dealt with exhaustively—rice, ragi, jola, sugarcane, cotton, coffee, tobacco and Arecanut, while others are less exhaustive—groundnut, potatoes, cocoanuts, etc. Very meagre information is presented with regard to pulses, some of the lesser millets, condiments and spices. Our author has gathered valuable data from the Administration Report of the Department of Agriculture, Mysore and other sources and has used them to make the subject-matter authentic and informative. But the serious lapse is that he does not disclose the source from which the information cited emanated. Thus the absence of a bibliography and due acknowledgements, make this bulky volume incomplete.

The value of the book would have been more enhanced if a uniform treatment of the subject-matter had been undertaken without such omissions, as seed-rate for all the crops, the cost of cultivation, latest information pertaining to the introduction of new varieties and that of manurial treatments. Implements used in the general practice of the cultivation in Mysore and those advocated have been mentioned. In many cases there are no descriptions of these implements, nor is there a photograph or photographs to show the nature of the implements. This would have served a very useful purpose for the novice, and for those interested in agriculture outside this State. Whilst perusing this volume, we were very much reminded of Buchanan's Travel in Mysore and South India. Despite the fact that this volume does not contain latest scientific terms and appliances, the wealth of information and meticulous details given in those volumes have yet to be surpassed.

All these remarks are not meant in anyway to detract the value and the usefulness of the book under review. The book will be of immense help to students in Agriculture, and of great utility to the staff of the Agricultural Department. We recommend this book appreciating the work that the author has undertaken to marshall all the facts and set them down as he has done.

L. S. D.

CORRESPONDENCE

"Wanted—Funds, More Funds, Yet More Funds!"—for The Mysore Agricultural and Experimental Union,—is the note of the following communication from Mr. B. V. Venkatacharya, B.Sc. (Ag.), Inamdar, Alkere, Mandya P.O.

To

The Editor,

The Mysore Agricultural Journal.

Sir,

It is now 25 years since the starting of The Mysore Agricultural and Experimental Union and we are on the eve of celebrating the Silver Jubilee. We can look back with pride on the achievement of the Union, and its efforts in bridging the gulf between the research station and the ryot. The number of members on its rolls and the Journal it is publishing bear ample testimony to the above. Yet shall we say—'So little is done and so much to do', in the cause of agriculture? Can we not strive a lot more to better the conditions of the Mysore Farmer? It is not too much if we state that our great limitation has been that of finance. The expenses of the Union are met from the membership fees, the subscriptions and generous help from the Government in the form of an annual grant amounting to Rs. 2,000. In spite of these, the Union is having a hand to mouth existence. It is just meeting the current expenses and is hardly able to save anything for permanent measures.

Do we require any funds at all for the Union? What could it do with funds when the entire Department of Agriculture is backing it up?

Research and Propaganda

The value of research depends upon the method of presentation and appeal. The result of Experimental work carried on the Research Station or the Subvention Farms should be widely made known to the Mysore farmer. It is the function of this Union through the pages of its Journal to narrate the experiences of its members to a wider group.

In another method, the Budapest, or nearer home, the Baroda method, propaganda could effectively be made by arranging a permanent exhibition or museum, the facts of research to be brought home in a concise form by models, charts or lantern slides. If we have to be useful in this manner, more funds and yet more funds are necessary.

Besides, it is very essential that we should be housed with ample accommodation to be able to do more work. We have an ever increasing responsibility to satisfy the 850 and more of its members. The staff should have more convenient room to attend to their increasing routine. More staff is also needed to meet the present and future demands for work. We have a big stock of journals, lafflets and bulletins on different aspects of comparative agriculture and allied subjects, obtained as foreign and inland exchanges, which have to be kept well bound and exhibited in *almirahs*. The subject should be easily accessible to the enquiring public. The present library should be enlarged such that it offers possibilities for study and research on 'economic' aspects of agriculture which is now being conspicuously omitted. All this requires Funds, ...More Funds.

If we are to emerge from the small position we are occupying now we cannot rely upon the subscriptions nor on the annual grants. We have to collect funds from munificent public, and approach Government for lumpsum grants to supplement. Every lawyer, merchant or public worker in this State is primarily attached to agriculture and it is rather unfortunate this latent source of income has not been tackled and that the sympathy to the cause of agriculture has not been sufficiently roused to extract an enormous munificence for building up the basic industry.

1. Large-hearted landlords, planters and businessmen should be approached either personally or through letters for generous monetary help for the Fund.
2. Every progressive agriculturist should be requested to become a patron; and
3. Thirdly, Government should be approached for grant of a similar amount.

Having come by the finance for the Union, the first expense should be for a better propaganda on the one hand and at the same time to provide for a spacious building, suitable furniture including almirahs, and an increase of staff. Next the library should be augumented and ample scope for research in agricultural economics, co-operation and marketing should be provided.

Let us not forget that the Mysore Agricultural and Experimental Union is the only one of its kind in India and has a wide scope and immense possibilities, provided, we resolve, plan and act.

Yours, etc.,

(*Sd.*) B. V. VENKATACHARYA.

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